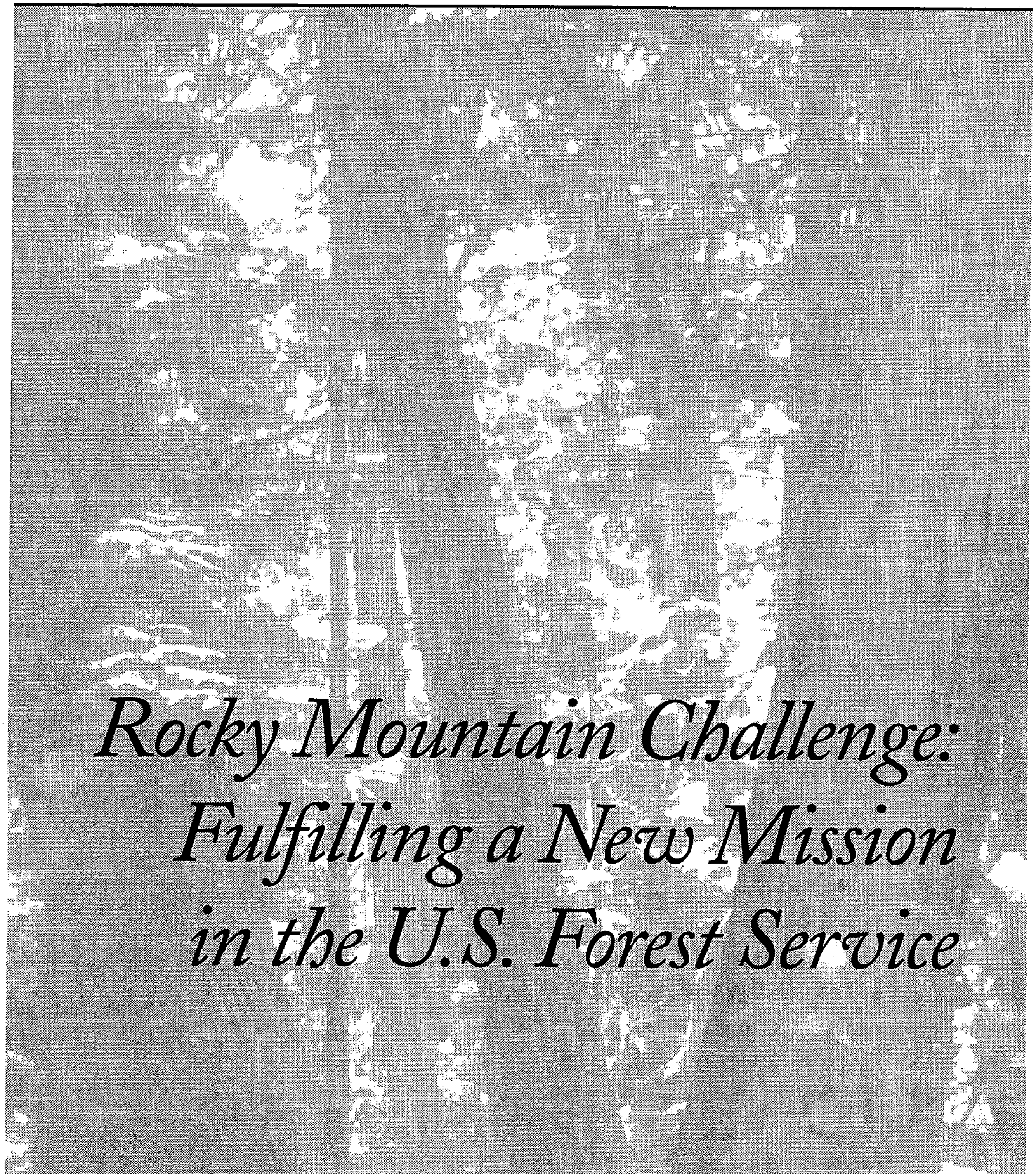
Barry



Rocky Mountain Challenge: Fulfilling a New Mission in the U.S. Forest Service

ASSOCIATION OF FOREST SERVICE EMPLOYEES FOR ENVIRONMENTAL ETHICS

This report published
February, 1994 by the

**Association of
Forest Service Employees
for Environmental Ethics**
P.O. Box 11615
Eugene, Oregon 97440
(503) 484-2692

AFSEEE is a 501(c)(3) non-profit organization dedicated to forging a socially-responsible value system for the Forest Service, based on a land ethic that ensures economically and ecologically sustainable land management. We commend the employees of Region 1 who are striving for sound resource management.

Cover art adapted from a photo by Rosalind Yanishevsky.

Old-Growth Overview: Fragmented Management of Fragmented Habitat

Rosalind M. Yanishevsky, Ph.D.

INTRODUCTION

The body of knowledge regarding the important role of old-growth forests in conserving biological diversity and protecting watershed integrity has grown significantly in recent years. Public concern about the fate of old-growth forests has grown in concert with scientific concern. The various National Forests in Region 1 have responded to new information about the significance of old-growth ecosystems in differing ways depending on the degree of controversy the issue has generated and on the initiative of individual Forest Service personnel. A unified and consistent Region-wide management approach has been lacking. It is becoming increasingly apparent, as the case studies included in this paper demonstrate, that an overall plan is needed for managing old growth in Region 1. More specifically, there is a growing need to: (a) conduct thorough inventories of the Region 1 old-growth resource, (b) manage for biodiversity and the persistence of old-growth forests through time, and (c) consistently monitor the effectiveness of management efforts to conserve old-growth habitat.

This paper is presented in six sections: (1) background information about the diversity of old-growth forest types and their state of decline in Region 1; (2) the factors responsible for the decline of old-growth forest ecosystems throughout Region 1, including piecemeal planning, excessive logging of low- to mid-elevation old growth, salvage logging, firewood cutting, fire suppression, and improper use of old-growth indicator species in forest management; (3) four case studies of forest planning and timber sales that typify many of the problem areas in Region 1 old-growth management; (4) positive examples of old-growth management, including improved old-growth inventories that are being developed on some Forests and the use of old-growth ecosystem mapping; (5) recommendations for changing old-growth management practices and for prioritizing areas for further study to fill significant gaps in current knowledge; and (6) an appendix showing compliance with Forest Plan requirements for old-growth retention, snag retention, and Management Indicator Species for each Region 1 National Forest.

Old-Growth Forest Types in Region 1

Region 1 supports a wide range of vegetative diversity, based in large part on the diverse climatic conditions that prevail in the Northern Rockies, from a moist, modified maritime climate west of the continental divide to the drier, continental climate east of the divide (Arno 1979). Slope, aspect and elevation are other key influential factors (id., Habeck 1988a).

The National Forest System contains the majority of the remaining old-growth forests in the Northern Rockies. Old-growth forest types vary from the luxuriant western redcedar and western hemlock in northern Idaho and northwest Montana, to the open, park-like ponderosa pine forests of south central Montana. Old-growth forest types perpetuated by repeated low intensity fire are termed seral, or subclimax old growth. In western Montana, seral old-growth forests generally range from 200 to 500 years old (Habeck 1988a). Seral old growth is typified by western larch and ponderosa pine types. Western larch can persist for 400 to 700 years and attain large size (over 4 feet in diameter and 190 feet tall [Barrett *et al.* 1991]). Old growth that is infrequently visited by fire will eventually become climax old growth. Climax old growth is typified by western redcedar and spruce/fir. Some old-growth characteristics usually develop within 200 years (*e.g.*, McClelland 1977, Habeck 1988a) and western redcedars may live for more than a thousand years (Parker 1986).

Historic vs. Current Amount of Old Growth

According to Habeck (1988a), "Many of the original mature seral forests were well over 200 years old in the mid-1800's." Habeck states that as recently as the late 1960's it was not uncommon to see fully loaded log trucks with 5 to 7 large diameter logs (greater than 30 inches) of western redcedar, western larch or ponderosa pine logs. Today, it typically takes 30 to 40 logs to make a load (*id.*).

The historic proportion of forests greater than 200 years old in the Northern Rockies was estimated using fire history studies and early timber inventories dating from 1937 to 1943, prior to effective fire suppression and most timber harvesting (Lesica 1993, Hart and Lesica 1993). Using these methods, old-growth forests were determined to occupy 20 to 50 percent of many forested ecosystems that existed prior to Euroamerican settlement (*id.*).

© R. YANISHEVSKY

These western redcedars on the Superior District, Lolo National Forest are four to ten feet in diameter.

Low-elevation old growth, which is generally the most valuable to wildlife (Harris 1984), is not well-represented in designated wilderness areas (Aney 1984). There are some good examples of old growth in Research Natural Areas (Habeck 1988b). Unfortunately, these areas are often small in size, isolated by clear-cuts and roads, and suffer from decades of development without regard to the ecosystem. Recreational designations containing old growth, such as campgrounds and picnic areas, are frequently fragmented and suffer from overuse. Such stands are biologically ineffective as habitat for old-growth dependent wildlife.

According to Region 1 Forest Plans, at most 10 percent of the forested area of each National Forest will be retained as old growth (Yanishevsky 1987, see also Appendix Table 1). However, many Forests use minimum criteria to define old growth that is to be retained (Yanishevsky 1987, U.S.D.A. Forest Service 1992), so the retained old growth may not be representative of historic old growth characteristics. Given the planned reduction of old growth from historic levels in biologically productive low-to mid-elevation forests, many wildlife and plant species dependent on old-growth habitat may become extirpated (Lesica 1993).

Biological Diversity of Old-Growth Forests

Old-growth forests are associated with biological diversity and ecosystem stability. Dependency of a species on old-growth habitat is correlated with its abundance in old growth (Ruggiero 1991). Numerous birds and mammals in the Northern Rockies find optimum conditions for breeding, feeding and/or shelter in old-growth habitat (*e.g.*, McClelland 1977, Harger 1978, Aney 1984, Habeck 1988a, Warren 1990). On the Kootenai National Forest in northwest Montana 58 species find optimum conditions in old growth, which is approximately 20 percent of the total number of birds and mammals occurring on the Forest (Kootenai National Forest Plan). Recent studies have shown that old-growth forests in the Northern Rockies have a unique abundance and/or richness of certain lichens, mosses and liverworts (Lesica *et al.* 1991), and that they contain an entire genus of beetles found only in forests over 500 years old (Ivie 1993, Keating 1993).

Like the northern spotted owl in the Pacific Northwest, many Northern Rockies wildlife species that rely on functionally intact old-growth ecosystems are on a downward trend. Fisher, Canada lynx and flammulated owl are candidates for tomorrow's endangered species list (Weaver 1993, Dobkin 1992). The old-growth dependent woodland caribou is already federally listed as endangered in Idaho and its numbers are below the accepted minimum viable population (Wakkinen 1993).

FACTORS CONTRIBUTING TO THE DECLINE OF THE OLD-GROWTH RESOURCE

The greatest cause of the decline of Region 1 old-growth forests is the legacy of high-grade and clear-cut logging and associated road building in low- to mid-elevation forests. Fire suppression has also significantly altered the natural succession of fire-dependent forest types. Removal of dead and dying trees by salvage, sanitation and firewood cutting can unravel old-growth ecosystems by the removal of critical old-growth components that may take decades longer to replace than their live counterparts.

Inconsistency among Forests and Districts in old-growth inventory methodology and analysis, as well as the degree to which information is field verified, is a recurrent theme.

This section shows how piecemeal planning by the Forest Service, and other management problems, have exacerbated the overall decline of old-growth forest ecosystems. In particular, the Forest Service has failed to develop comprehensive, reliable old-growth inventories and failed to account for habitat fragmentation in both large-scale planning of land uses and planning of individual projects. Lastly, the program for managing indicator species is not serving its intended purpose, because the species chosen to indicate the health of old-growth ecosystems are being managed at or below minimum thresholds, are not being properly monitored, and do not accurately represent the habitat needs of other old-growth species.

The Consequences of Piecemeal Planning

Incomplete old-growth inventories. Without inventories of old-growth habitat on a landscape level, it is impossible to analyze the cumulative effects of timber management. In most instances, the Forest Service narrows the scope of its old-growth inventories and

© R. YANISHEVSKY

Cedars in Region 1 are susceptible to "heart-rot" and have little commercial value. For that reason they often end up being piled and burned in timber sale operations.

decisions whether to retain old growth to limited areas around proposed timber sales — often disregarding the landscape context of adjacent analysis areas, the District, the Forest, and adjacent public and private forests.

For example, in the Little Joe timber sale on the Superior Ranger District of the Lolo National Forest, the agency planned to clear cut an old-growth western redcedar grove containing trees four feet in diameter at breast height (DBH). The Forest Service prepared a map of the timber sale analysis area and maintained that western redcedar old-growth forests were common. National Audubon Society Adopt-a-Forest maps (*see Appendix*) of the entire Superior Ranger District and Lolo National Forest showed quite a different picture. The Little Joe drainage and the immediate vicinity had a concentration of cedar old-growth forests; however, the rest of the District and Forest were relatively devoid of old-growth cedar. In order to make reasoned management decisions, accurate, field-verified information and maps must be available showing the location and type of old-growth habitat at the District and Forest levels. Fragmentation effects cannot be assessed without maps displaying contiguous old-growth blocks relative to acres affected by past logging. (Upon viewing these Adopt-a-Forest maps, the District Ranger altered her decision to clear cut the old-growth cedar grove.)

With varying degrees of reliability, every Region 1 Forest, except the Custer, is doing some level of old-growth mapping. With the exception of certain Forests in northern Idaho, the Forest Service typically prepares old-growth maps only for specific analysis areas, and only when a timber sale is proposed. This piecemeal approach addresses only one small land area at a time, involves only a small portion of the total land base, and does not provide sufficient information to assess cumulative effects. The maps are based mainly on various inventory methods, which can range from photo interpretation to queries of stand exam data or simply personal knowledge of Forest Service personnel. Often only a small sample of field data is collected to verify the Forest Service maps.

Inconsistency among Forests and Districts in old-growth inventory methodology and analysis, as well as the degree to which information is field verified, is a recurrent theme. The Idaho Panhandle National Forests, for instance, have field-verified a substantial proportion of their old-growth stands; however, the proportion varies among Ranger Districts. On the Flathead National Forest, one District identified old growth without any field verification (Lost Silver timber sale). On another District, most old growth was identified in habitat blocks for Management Indicator Species, but none was verified outside the blocks for the 10 percent retention requirement (Hornet Wedge timber sale). Field-verification methodologies were different on each District.

Completing accurate inventories of National Forest resources is a key requirement of the National Forest Management Act (16 U.S.C. § 1603). Nearly 13 years into NFMA planning, old-growth ecosystems in Region 1 have yet to be adequately inventoried. No Forest has a reliably complete inventory and (with the exception of the Idaho Panhandle National Forests) most inventories continue to be performed on a piecemeal basis. At this rate, by the time the inventories are complete, many options will have been irreversibly foreclosed on what is, for all practical purposes, a nonrenewable resource.

> *"It may well be that in the Northern Region we will never know the full effects of such fragmentation on old-growth, Douglas-fir/ponderosa pine ecosystems, as only relatively small remnant patches remain in the northern Rockies."*
> *D.S. Dobkin*

Old growth fragmentation is not taken into account. Conservation biologists agree that habitat fragmentation is one of the greatest threats to biodiversity worldwide (*see e.g.*, Wilcox 1982, Wilson 1988, Noss 1992). The Forest Service asserts that forest types of the Northern Rockies are naturally more open and therefore may not be subject to similar fragmentation effects documented in forests of the east and west coasts (*e.g.*, Flathead Old-Growth MIS DEIS). The mosaic pattern of western montane forests is different from eastern deciduous forests, where most fragmentation studies have been conducted. No data, however, substantiate the implication that these forests are not subject to similar fragmentation effects (Noss 1992). In fact, it is contrary to findings to date (*e.g.*, Aney 1984, Hejl in preparation).

Only a handful of studies, summarized by Dobkin (1992), have investigated the impacts of forest fragmentation on birds in western coniferous forests, and only one (Hejl, in preparation) is explicitly designed to examine the effects of fragmentation on old growth in the Northern Rockies. Hejl's initial results point to a highly significant increase in the number of cowbirds, a brood parasite, in fragmented, old-growth Douglas-fir/ponderosa pine ecosystems, despite these stands being naturally more open. Dobkin (1992) states:

> It may well be that in the Northern Region we will never know the full effects of such fragmentation on old-growth, Douglas-fir/ponderosa pine ecosystems, as only relatively small remnant patches remain in the northern Rockies (Aney 1984, Hejl and Woods 1991, Moore 1992).

Paralleling the results seen in remnant forest patches of eastern deciduous forests (see review by Dobkin 1992), Aney (1984) found that bird species richness in western Montana increased significantly with stand size and concluded that, "some species of birds [*e.g.*, pileated woodpecker] were sensitive to fragmentation of old-growth stands, as they occurred only in large stands." In summary, not only is the Forest Service neglecting to consider the likely effects of fragmentation, but past forest management actions may have foreclosed our opportunities ever to know the full effects of fragmentation.

The Consequences of Excessive Logging of Low- to Mid-Elevation Old Growth

Logging is the major cause of the loss of the old-growth resource (Cooper *et al.* 1987, 1994). Old-growth ecosystems in Region 1 are in a state of serious decline relative to their historic abundance. Certain old-growth forest types are especially rare. Ponderosa pine is the most endangered old-growth forest type in Montana (Hejl 1988, Yanishevsky 1993). Daniels (1991b) notes that:

> Historically, ponderosa pine communities were a significant component of old growth on the Lolo . . . Low-elevation pine communities were among the first trees to be harvested in the late 1800's . . . A large amount of pine on national forest land was logged in the 1960's.

Losensky (1993) estimates that approximately 50 percent of the ponderosa pine cover type was old growth in Region 1.

> *The greatest cause of the decline of Region 1 old-growth forests is the legacy of high-grade and clear-cut logging and associated road building in low- to mid-elevation forests.*

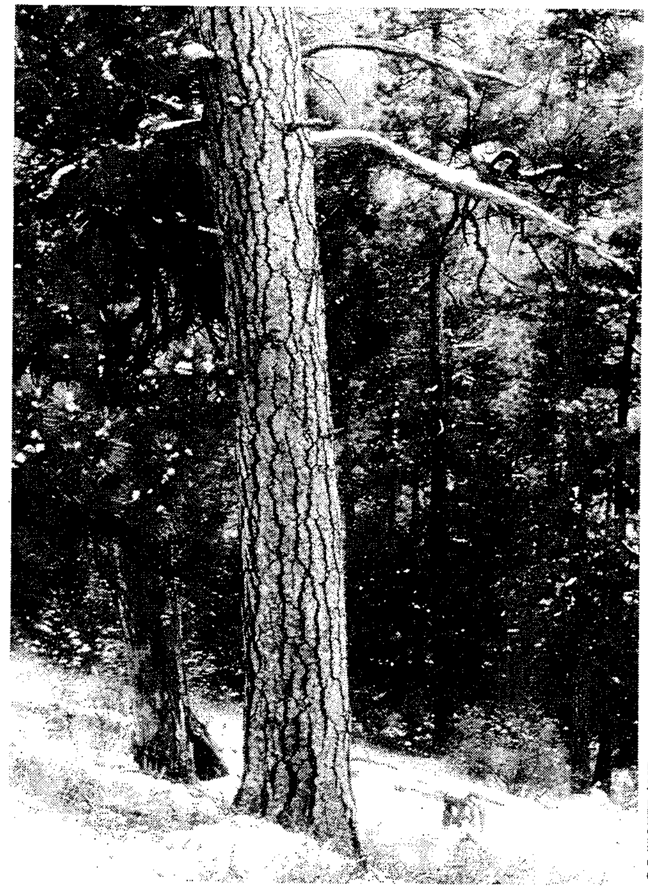
Old-growth white pine and western larch have also significantly declined. "[M]agnificent old-growth stands of white pine and western larch also were present at the time of Euroamerican settlement." (Habeck 1990). Today, western white pine old growth is extremely rare, having been subjected to extensive logging and disease from blister rust (Graham 1994a and 1994b).

Flammulated owls are limited to ponderosa pine and mixed ponderosa pine/Douglas-fir forest types and have a high affinity for old-growth (Mannan and Meslow 1984, Reynolds *et al.* 1988, Hejl and Woods 1991, Dobkin 1992, Hoffland 1994). Little is known about the population status of this unusual, primarily insectivorous and probably migratory owl (Holt and Hillis 1987, Reynolds *et al.* 1988, Dobkin 1992). The first documented nest site in Montana was felled by a firewood cutter in 1985 (Holt *et al.* 1987). Dobkin (1992) warns that the species has disappeared from portions of its breeding range where old-growth ponderosa pine and Douglas-fir have been highly fragmented. Reynolds *et al.* (1988) rank the flammulated owl as most urgently in need of research on the effects of forest management.

Western redcedar old-growth forest types have also been significantly reduced in abundance. In western Montana, prior to 1900, moist low-elevation sites supported forests of 300 to 500 year old western redcedar and western hemlock. Historic accounts on the Bitterroot Forest Reserve describe western redcedar trees up to 12 feet DBH and stands 1,000 years old (Leiberg 1899).

In 1980, Parker (1986) attempted to locate ancient western redcedar groves in the Northern Rocky Mountains. She found 42 groves in Region 1 that met her criteria. Another 88 were possible groves, but not examined. Together, the Clearwater and Kanisku National Forests had nearly half of the ancient cedar groves. These groves contained trees commonly 4 feet DBH and sometimes reaching over 12 feet DBH. No one knows how long it takes for a stand to become old growth, but it is far longer than the age of the large, dominant trees in the stand, which are typically 300 to 500 years old. Parker's sampling estimated the western redcedar groves at 1,000 to 2,000 years old, with the oldest individual approximately 3,000 years old (*id.*).

Parker states that although the majority of today's remnant western redcedar groves are found in moist habitat types, two were found in relatively dry habitat types *(Thuja plicata/Clintonia uniflora)*. She believes that even such dry western redcedar habitat types can support large individuals if protected (*id*). (A habitat type is the potential climax community.)



© J. HOFFLAND

Ponderosa pines are a fire-resistant species and often occur in open, park-like stands. Some individuals may have 30 fire scars accumulated over 400 years.

Despite protective designations in some cases, Parker found only two western redcedar groves in northwestern Montana that were undisturbed or protected sufficiently to be considered functional biological reserves. Deficiencies in the other groves were largely related to adjacent clear-cutting, small size, roads and recreational impact (*id*). As of 1980, 16 of the 42 groves were slated for logging (five on the Clearwater Forest alone; *id.*). In the last decade, undoubtedly, more have been cut.

Although western redcedar has always been regionally scarce, it is estimated that about 60 to 80 percent of National Forest cedar stands in western Montana and northern Idaho, respectively, were old growth prior to Euroamerican settlement (Losensky 1993). Private land, which typically contains more productive forests, would be expected to contain a higher percentage of old-growth forests. It is clear that biologically functional old-growth western redcedar groves have all but vanished from the landscape (Parker 1986). Whatever remains of the ancient cedar forests should be considered a high priority for retention and protection from further logging, fragmentation, and disturbance. In addition, to restore the redcedar old-growth type, mature cedar stands should be retained to allow them to develop into old-growth habitat.

The Consequences of Excessive Salvage Logging and Firewood Cutting

Dead or dying trees, whether standing or down, are major defining characteristics of old-growth forests (Thomas 1979, Franklin *et al.* 1981). These trees function as habitat for a plethora of plant and animal species and have innumerable other critical functions in nutrient cycling and release, moisture holding capability, soil stabilization, and mycorrhizal colonization (*see e.g.,* Maser 1988). The larger the tree, the better it performs its function in contributing to the complexity and stability of old-growth ecosystems (*id*).

Insectivorous birds, foliage-foraging ants and other canopy arthropods consume insect pests (Campbell and Torgersen 1982, Frear 1982, Takekawa and Garton 1984, Schowalter 1988, Torgensen *et al.* 1990). Populations of these natural enemies of forest pests increase with the presence of snags and down logs (Perry 1988, Schowalter 1988, Torgensen *et al.* 1990). The presence of these species can extend the interval between outbreaks of irruptive pest species (*e.g.,* Takekawa and Garton 1984, Holmes 1990). This is but one way that retention of snags and down trees contributes to the overall health of the forest ecosystem. In addition, disease and insect infestation (*e.g.,* dwarf mistletoe [Bennetts 1991, Mlot 1991]) and mountain pine beetle [Romme *et al.* 1986]) have been shown to increase biodiversity in forested ecosystems. These aspects of forest health are often overlooked by forest managers (*see e.g.,* Takekawa and Garton 1988, The Wilderness Society 1989, Lawson 1990, Jensen 1992, Frost 1993).

Where western larch exists, standing dead relics are preferred by pileated woodpeckers (McClelland 1979). Larch is also a highly desired firewood species. Cutting of dead larch and ponderosa pine for firewood may seriously degrade woodpecker habitat (Frissel 1984). Pileated woodpeckers in northwestern Montana select nesting trees averaging 30 inches DBH (McClelland 1979 and 1989). Large larch trees and snags which are near roads are seldom left, even when such areas are marked as wildlife habitat (Caton 1993). Any old-growth stand adjacent to an open road is likely to be eventually cleared of its sound snags and down logs within at least 300 to 600 feet from the road (Kantor 1983 and 1987).

The Hornet Wedge timber sale on the Flathead National Forest provides an example of an unintended consequence of salvage logging in old growth. Unit 5 of this timber sale had been previously salvage logged, but using Forest Service scoring methods, it still scored as one of the best remaining old-growth stands in the sale area (Schultz 1992a). The drainage containing the sale area was essentially at the minimum 10 percent old growth required by the Flathead Forest Plan (*see Appendix, Table 1*). Nevertheless, this proposed unit with its large volume made the sale attractive. Because the old-growth stand had been salvage logged and, therefore, was marginal in snags and down woody material, it now appears acceptable to cut the stand. This points out a potential liability of salvage logging — once salvaged, a stand may cease to qualify as old growth, and may become eligible for clear-cutting. (The Forest Service eventually agreed to delete Unit 5 from the timber sale.)

A potential liability of salvage logging [is that] once salvaged, a stand may cease to qualify as old growth, and may become eligible for clear-cutting.

The Consequences of Fire Suppression in Fire Dependent Old-Growth Communities

The impact of 60 years of fire suppression on old-growth forests in Region 1 arguably is relatively small compared to decades of road building and clear-cut logging. The effects of fire suppression are not insignificant, however, and will become a factor of greater significance with time.

Old-growth forest types that were typically maintained by the frequent occurrence of low-intensity fire include fire resistant species such as ponderosa pine (Habeck 1988a) and western larch (although western larch can also occur on sites with mixed severity and stand replacing fire regimes [Barrett *et al.* 1991, Arno and Fischer 1994]). These species may survive repeated fires; ponderosa pines have been found with more than

30 fire scars accumulated over 400 years (Leiberg 1899).

Inland Douglas-fir is a natural component in old growth stands in ravines and riparian sites subject to infrequent fire (Habeck 1988a), but on dryer sites where the normal fire regime has been suppressed, the fire resistent tree species become crowded by the more shade tolerant Douglas-fir (Habeck 1988a), and the stands do not develop characteristic structural features of old-growth ponderosa pine and western larch. For example, the dominant overstory trees may not obtain as large a diameter due to increased competition for nutrients and sunlight. When old-growth structure is altered, ultimately its composition and function can expect to be altered (Franklin and Spies 1991).

When old-growth structure is altered, ultimately its composition and function can expect to be altered

Fire suppression in fire-maintained forest types promotes increased understory fuels and "fuel ladders" (Barrett 1992). Fuel ladders are low-and mid-canopy trees that are capable of carrying fire from the understory to the canopy of the overstory trees. Future fires in such fuel laden stands would thus be expected to increase in severity, killing many of the old, overstory trees that previously survived numerous low intensity fires (*id.*)

Fire suppression began in the early part of this century and became quite effective by the mid-1930s (Wellner 1970). In relatively moist forest types, alteration of fire cycles has primarily reduced low-intensity, non-lethal fires, but has not significantly reduced high-intensity, stand-replacing fires (Barrett *et al.* 1991, Barrett 1992).

> [I]n relatively moist forest types . . . [s]ince weather and fuel conditions, not ignition sources, are the predominant influences determining stand replacement events, these forests will continue to burn more or less 'on schedule'. Studies (*e.g.*,Johnson *et al.* 1990) suggest that [in such cases] climate, not fire suppression, is the predominant factor controlling the occurrence of large stand replacing fires.
>
> (Barrett 1992).

Forest practices should ideally mimic the natural pattern of low-intensity fire in many forest types, but the practice of high-grade, or selective logging of the giant ponderosa pines has actually accelerated conversion of stands to more shade tolerant species like Douglas-fir (Shearer and Schmidt 1970, Arno 1987). The pattern of logging has been like trophy hunting — the large, western larch, ponderosa pine and moist site giants, the trees most likely to survive decades of repeated fires, were the very ones sought out and culled. Fire suppression and harvest practices actually contribute to increasing risk of high-intensity stand-replacing fires.

Today's challenge is to maintain old-growth characteristics by reintroducing fire and/or mimicking the mosaic patterns and physio-chemical effects of wildfire without causing mechanical damage to the land. If salvage and fire mimicking logging practices are treated as a panacea, they could cause further damage to the ecosystem. If overused as a justification to log in old growth, public confidence will be further eroded.

Today's challenge is to maintain old-growth characteristics by reintroducing fire and/or mimicking the mosaic patterns and physio-chemical effects of wildfire without causing mechanical damage to the land.

The Consequences of Improper Use of Management Indicator Species

The Forest Service uses a few selected indicator species as a tool to estimate the effects of forest management on a wider range of forest species that are believed to be dependent on similar attributes of the environment (*see* Forest Service Manual sections *2621* and *2622*). The theory is that if the needs of indicator species are met, the needs of associated species will also be met.

Landres *et al.* (1988), however, has pointed out serious shortcomings in the use of indicator species. Extrapolation from one species to another as an indicator of population trends is difficult or impossible, in part because no two species have identical habitat requirements nor identical mechanisms of population regulation (*id.*).

Given the extreme complexity of ecosystems in general, and old growth ecosystems in particular, it is likewise improbable for a single species to serve as an index of the structure and function of the larger ecosystem (*id.*, Noss 1990). Many different old-growth forest types exist. They are not interchangeable. In addition, differences emerge in the structure, function and composition of individual old-growth stands as they age. In other words, a 200-year-old old-growth stand is not the same as a 300- or 400-year-old stand (Juday 1978, McClelland 1985, Spies and Franklin 1991).

No Forest in Region 1 has developed standards for Management Indicator Species (MIS) that meet the requirements of all old-growth species (see Appendix). Designating and monitoring more indicator species will improve but not solve this problem. The situation will improve only if the habitat requirements of a wide range of old-growth species are well-researched (and provided for) and if populations are consistently inventoried and monitored.

Furthermore, populations of MIS should not be managed by using minimum habitat standards. MIS standards should take into account the known requirements of old-growth dependent and associated species as well as the enormous gaps in current knowledge of the long-term requirements of these species, and about old-growth ecosystems *per se*.

The discussion below outlines the inadequacies of Region 1's program for inventorying and monitoring indicator species, as well as the pitfalls of using minimum habitat standards (see Appendix for details on individual National Forests).

Shortcomings in the Region 1 MIS program. No Forest in Region 1 has performed a systematic inventory of its old-growth MIS (Appendix, Table 3). Without a baseline population inventory, project outputs will be uncertain and it will be impossible for indicator species to serve their intended function — to determine the effects of management on old-growth MIS populations and other species associated with similar old-growth habitat. The Region 1 MIS Monitoring White Paper (1989) admits,

> [a]lthough NFMA regulations ... mandate ... output analysis for MIS species, with the exception of big game species, most [Region 1] Forests ignored this requirement ... [W]e're really hurting in this area.
>
> (U.S.D.A. Forest Service 1989).

Region 1 has also failed to adequately monitor old-growth MIS. The MIS Monitoring White Paper states:

> Of all the wildlife information assessed in the FEIS's, monitoring had the greatest variability.... [Most] forests developed very nonspecific MIS monitoring plans of dubious value [or] ... largely ignored the whole issue of MIS monitoring.
>
> (*id.*)

No Forest in Region 1 has developed standards for Management Indicator Species that meet the requirements of all old-growth species. Designating and monitoring more indicator species will improve but not solve this problem. . . Another dangerous tendency of the Forest Service is to manage for habitat minimums, rather than a range about the mean.

To date, there has been little monitoring of MIS populations and the Forest Service has failed to generate enough monitoring data to be useful in making forest management decisions (*see Appendix, Table 3*).

Another dangerous tendency of the Forest Service is to manage for habitat minimums, rather than a range about the mean. The use of minimum standards in complex biological systems in general is:

> likely to create homogeneous conditions... rather than a natural mosaic or range of habitat and presumably population conditions. Under the former condition the diversity, resilience and resistance to disturbance of all populations may be compromised ... [increasing the potential] for regional extinction.
>
> (U.S.D.A. Forest Service 1993a).

The American Ornithologists' Union reviewed the Recovery Plan for the endangered red cockaded wood-

© J. HOFFLAND

Woodpeckers have excavated cavities in this snag.

pecker, a species that is dependent on old pines of the southeastern United States. According to the ornithologists, the recovery plan had one serious, general shortcoming that makes it untenable: the repeated emphasis on minimal values. As required by the plan, minimal area required to sustain a group, minimal age of the trees used, and minimal population sizes put the species at unjustifiable risk, allowing no margin of safety in the event of researcher error, climatic variation, or other factors (Jackson 1986).

Conner (1979) indicates that cavity nesting birds may be threatened by management strategies based on minimums. The pileated woodpecker is of special concern. Most forest woodpeckers probably evolved in a relatively stable environment, in which natural selection favored individuals that use trees closest to the mean size (*id.*). Providing minimum or suboptimal conditions is likely to lead to low nesting success, gradually eliminating such species (*id.*).

Even if the arithmetic mean of a criteria (such as snag DBH) is used as a management standard, rather than the minimum value for that criteria, the consistent use of habitat components of average measure could pose risk to a species; because with a normal distribution, by definition, approximately one half of the individuals select habitat components larger than the mean. The mean diameter of pileated woodpecker nest trees in northwest Montana is 30 inches DBH (McClelland 1979 and 1989). The standard for "large" snag retention on most Forests in Region 1 is 20 inches DBH minimum (Appendix, Table 2). Of 106 pileated woodpecker nest trees, McClelland found only 12 nest trees (11 percent) less than or equal to 20 inches DBH (McClelland 1989). Clearly, a "large" snag standard of 20 inches DBH cannot ensure the long-term viability of pileated woodpeckers that need larger trees for nesting. Similar arguments have been presented for other pileated woodpecker minimum management requirements (*see e.g.*, Caton 1992, Gross 1993) and other old-growth MIS, such as the pine marten and northern goshawk (*see e.g.*, Johnson 1992, Noss 1992, Resources Limited/Five Valleys Audubon Society 1992, Soukkala 1992, Natural Resources Defense Council 1993).

CASE STUDY ONE

The Faulty Region 1 "Definition" of Old Growth

In 1989, the National Old-Growth Task Group formulated a "Position Statement on National Forest Old-Growth Values" and a "Generic Definition and Description of Old-Growth Forests" (U.S.D.A. Forest Service 1989). As a result of Washington Office directives, Region 1 established an Old-Growth Committee. In April 1992, Region 1 issued a document entitled "Old-Growth Forest Types of the Northern Region," which presented Old-Growth Screening Criteria for specific zones of Western Montana, Eastern Montana, and North Idaho (U.S.D.A. Forest Service 1992). This was an attempt to standardize criteria for classifying the variety of old-growth types across the Region. The definition process is now considered complete (Jolly 1992). The committee, however, executed this task without the benefit of outside scientific peer review or public input, either during or after the process (Yanishevsky 1990, Schultz 1992b). Moreover, the methodology used by the committee was unscientific and did not even include gathering field data to verify the characteristics of old-growth stands as a basis for the definition (*id.*).

A former member of the Region 1 Old-Growth Committee described a "definition process" that relied heavily upon the Committee members' pre-conceived notions of the quantifiable characteristics of old-growth forests (Schultz 1992b).

> The old-growth definition in its present state, without field verification of assumptions, and without addressing the issue of quality, is inadequate to scientifically describe, define, delineate, or inventory old-growth ecosystems.

(*id.*) Not only did the Committee fail to obtain new field data on old-growth forest characteristics, it failed even to use existing field data on old-growth definition and classification previously collected for Region 1 (Pfister 1987). Quality of old growth was not addressed during the definition process. The Committee did not take into account the legacy of logging that has already destroyed much of the best old growth. This approach skewed the characteristics that describe old-growth forests toward poorer remaining examples.

Our investigation shows that the Region 1 old-growth criteria are now being used for decision-making on most Region 1 Forests. It is premature for the Forest Service to base management decisions with long-term environmental effects on its Region 1 old-growth criteria, until these criteria are validated by the larger scientific community.

CASE STUDY TWO

Flathead Forest Old-growth Management Indicator Species DEIS

As a result of administrative appeals to the Forest Plan, the Flathead National Forest prepared a Draft Environmental Impact Statement (DEIS) on management of old-growth indicator species. This DEIS, released in 1992, was the first attempt in Region 1 to deal with old-growth MIS on a Forest-wide basis. As such, the project has implications for other Forests in the Region

The Flathead old-growth DEIS drew widespread criticism from the scientific community (*e.g.,* Barrett 1992, Caton 1992, Harrison 1992, Johnson 1992, Landres 1992, McClelland 1992, Nel 1992, Noss 1992, Schultz 1992a and b, Soukkala 1992, U.S.D.I. 1992). Noted conservation biologist Dr. Reed Noss concluded that the process was "corrupt pseudo-science," noting that the

> liberal use of the latest ecological jargon [*e.g.,* "ecosystem management"] and frequent reference to technical literature [gave] a superficial impression of scientific validity . . . [but] underlying this veneer is a severely flawed conceptual and analytical approach . . .
>
> (Noss 1992).

It is premature for the Forest Service to base management decisions with long-term environmental effects on its Region 1 old-growth criteria, until these criteria are validated by the larger scientific community.

A brief look at two major aspects of the Flathead old-growth MIS DEIS — quantification of the amount of old growth on the Flathead and the use of minimum MIS standards — shows serious problems with the Forest Service's most ambitious attempt to deal with old growth in Region 1 (see also Yanishevsky 1993).

Amount of old growth on the Flathead. The Forest Service estimated the amount of old-growth forests that existed on the Flathead National Forest prior to Euroamerican settlement by interpreting a U.S. Geological Survey dating from 1898-1899 (Ayres 1900 and 1901). The Forest Service took Ayres' anecdotal, broad brush survey, done on horseback through difficult terrain, and made arbitrary assumptions as to what was old growth and what was not (Barrett 1992, Noss 1992, Resources Limited/Five Valleys Audubon Society 1992). Based on this information, the DEIS concluded that at the turn of the century no high-elevation land, 8 percent of mid-elevation land and 29 percent of low-elevation land were covered by old-growth forests. This equated to a total of only 6 percent old growth for the Flathead Forest. The Ayres' reports (1900 and 1901) did not contain site-specific detail that would allow testing of the Forest Service's questionable assumptions (*id*).

In contrast, Lesica (1993) used a different methodology — fire frequency — to estimate the amount of historic old growth (>200 years) in the Northern Rockies. His methodology was validated using a combination of Forest Service timber stand inventories from the late 1930s, modern Forest Service timber stand inventories, and additional field verification (Lesica 1993, Hart and Lesica 1993). Lesica found that 28 to 53 percent of the area covered by spruce/fir and western redcedar forest ecosystem types, in the mid-to low-elevations of the Northern Rockies were old-growth forests (*id.*). Losensky (1993) also used 1930s timber stand inventories to model the percentages of historic old growth in all forest types in Region 1. The methodologies have not been presented in a final report; however, the draft appears consistent with Lesica (1993).

The Flathead DEIS for MIS made a surprising conclusion using LANDSAT satellite imagery — today there are more than three times the amount of old-growth forests (20 percent total old growth) that existed prior to Euroamerican settlement.

The Flathead DEIS for MIS made a surprising conclusion using LANDSAT satellite imagery — today there are more than three times the amount of old-growth forests (20 percent total old growth inside and outside wilderness) than existed prior to Euroamerican settlement. The DEIS methodology involved correlating satellite spectral classes to ground-derived stand characteristics. However, an expert in identifying old-growth forests using satellite imagery found a host of scientifically unsound assumptions underlying the Flathead Forest's methodology (Nel 1992). The problems with methodology were compounded by inadequate field verification (*id.*). Nel described how the Flathead's methodology could misidentify young stands, and even clear-cuts on a shadowed slope, as old growth.

The DEIS then assigned LANDSAT spectral classes to the draft old-growth definition criteria for the Region 1, Western Montana Zone which, as discussed above, are also of questionable validity (Schultz 1992b, Noss 1992). The DEIS thereby concluded that 20 percent old growth currently exists on the Flathead inside and outside wilderness. National Audubon Society Adopt-a-Forest maps, which are based on criteria developed from timber stand data queries of field verified old-growth stands (*see* Appendix), indicate that approximately 9.5 percent of the forested acres outside of wilderness are candidate old-growth stands.

To test the accuracy of the LANDSAT/GIS maps, independent field verification was undertaken using the Flathead Forest's field sampling methods (Schultz 1992a). Only 29 percent of the plot samples met even the minimum Region 1 definitions of old growth (*id*). In addition, as predicted by Nel (1992), some areas identified as old growth contained no mature trees and were in fact clear-cut.

Flathead Old-Growth MIS DEIS Standards

In order to maintain a biologically diverse landscape and the long-term integrity of old-growth ecosystems, Management Indicator Species (MIS) must serve as a barometer of the effects of forest management on old growth (Soukkala 1990, U.S.D.I. 1992). Interestingly, the Flathead Old-Growth MIS DEIS claims that old-growth biodiversity issues are outside the scope of the document, despite recent court rulings in the Pacific Northwest requiring the agency to analyze the impacts of management on all old-growth species (*Seattle Audubon Society v. Moseley*, 798 F. Supp. 1473, (W.D. Wash. 1992)). Furthermore, the MIS chosen by the Flathead — the pine marten, pileated woodpecker and barred owl — do not accurately represent the habitat requirements of other old-growth dependent and associated species. For instance, the fisher and northern goshawk require greater quantity and/or quality of old-growth habitat (fisher: Freel 1991, Natural Resources Defense Council 1992; goshawk: Hayward and Escano 1989, U.S.D.A. Forest Service 1991, Marshall 1992 and 1993, Natural Resources Defense Council 1992 and 1993).

Interestingly, the Flathead Old-Growth MIS DEIS claims that old-growth biodiversity issues are outside the scope of the document.

The Flathead Old-Growth DEIS strives for minimum habitat requirements of MIS as a management goal (Resources Limited/Five Valleys Audubon 1992). Managing for minimums is a risky management strategy. (*See the discussion above regarding the effect on pileated woodpeckers of minimum snag retention standards.*) A preferable strategy would be to manage wildlife habitat closer to the mean, safely within the range of natural variability. If such a policy were to be followed, minimum habitat parameters would be reached infrequently as a consequence of some large scale natural disturbance, not as a management goal.

In addition to using biologically untenable minimum requirements for the three chosen indicator species (examples of which are provided below), the Flathead Forest shows a history of progressive weakening of its own standards starting in 1989, when earlier drafts of its old-growth MIS standards were released (Resources Limited/Five Valleys Audubon Society 1992). No biological rationale was given for the steady erosion of standards for all three indicator species. Examples follow to illustrate the DEIS' treatment of four assumptions regarding pine marten habitat and population viability.

In addition to using biologically untenable minimum requirements for the three chosen indicator species, the Flathead Forest shows a history of progressive weakening of its own standards starting in 1989, when earlier drafts of its old-growth MIS standards were released

Marten Dispersal Distances. One key factor used in the DEIS to determine the amount of old-growth habitat to be retained is "dispersal distance"—the distance that juvenile marten will travel to establish their own territories. The greater the dispersal distance, the less old growth must be retained due to the finite boundaries of the National Forest. As explained below, the standards employed by the Flathead Forest did not properly interpret existing data.

In 1989, the earlier draft of the MIS standards assumed that marten dispersal distance was three miles (see Proposed Appendix S and Amendment 14, Old-Growth Habitats: Characteristics, Management Indicator Species and Management Guidelines, 11/89). Without supporting justification, the 1992 DEIS increased the dispersal distance to 6 to 15 miles. According to Nygren (1989), even a three-mile dispersal limit is likely to result in dramatic reductions in the population, which could threaten the viability of the species (Fisher 1989, Soukkala 1990 and 1992, Johnson 1992, White 1993). Extended dispersal distances, and consequent retention of less old growth, are particularly likely to have negative impacts on the marten population because the existing habitat is already extensively fragmented. Even though marten are known to avoid large openings (Fisher 1989), the DEIS made no effective provisions for the quality of habitat between retained fragments of old growth.

Even though marten are known to avoid large openings (Fisher 1989), the DEIS made no provisions for the quality of habitat between retained fragments of old growth.

Failure to Protect Lower Elevation Old-Growth Marten Habitat. Another problem with the DEIS is that it incorrectly represented marten as using predominately high-elevation habitat. This misrepresentation led to a standard that reads: "preference should be given to locating old-growth habitat areas on lands not suited to timber production" (DEIS, Appendix S-4). The Forest Service failed to cite any evidence to support the implication that the natural distribution of marten does not include low-elevation, high-productivity, old-growth forest areas that are suitable for timber production, yet MIS blocks to be retained were preferentially placed on lands not suitable for timber harvest. The lower elevation old growth, which the DEIS admits is relatively scarce, would be open to further logging and fragmentation. This action would result in an alteration of the natural distribution of marten and probably violate NFMA regulations regarding species viability (Hilmon 1992).

Marten Habitat Quality. Marten require many more and larger snags and down wood than provided by the DEIS standards. For denning habitat, the DEIS required down logs averaging only 10 inches in diameter, whereas the average size should be at least 20 inches (Soukkala 1990), with at least 3 snags per acre greater than 24 inches in diameter at breast height (DBH) (Freel 1991).

Marten Viability Modeling. Population modeling expert Harrison (1992) and marten biologist Soukkala (1992) both pointed out major errors in the viability model used in the Flathead MIS DEIS. For example, "The model assumes juvenile marten breed and have young as yearlings (which is wrong) and assumes that young marten reproduce at rates equal to those of adults (which data do not support)." (Soukkala 1992, parenthesis in original). The model also incorrectly used data presented in Soukkala's thesis regarding marten recruitment and natural mortality and disregarded the fact that a fragmented landscape may reduce recruitment and survival rates (*id*). These serious modeling errors contribute to the DEIS' biologically

The Flathead Forest's Old-Growth MIS DEIS is the most concerted effort to date regarding old-growth management in Region 1. Nevertheless, serious shortcomings exist concerning the basic scientific soundness of the old-growth inventory and MIS standards.

insupportable conclusion that viable populations of marten will be maintained.

The Flathead Forest's Old-Growth MIS DEIS is the most concerted effort to date regarding old-growth management in Region 1. Nevertheless, serious shortcomings exist concerning the basic scientific soundness of the old-growth inventory and MIS standards.

[The Ranger] decided to amend the Forest Plan to fit the decision, rather than amend the decision to comply with the Forest Plan.

CASE STUDY THREE

Ecosystem Management and the Stevensville Southwest Timber Sale

The Bitterroot National Forest is experimenting with ecosystem management in the Stevensville Southwest (SSW) timber sale. By using prescribed burns, this sale proposes to "return the [area] to a normal stand structure and species composition that reflects the historical fire regime" (SSW Silvicultural Diagnosis and Prescription, 7/19/93).

Old-growth habitat, however, will be reduced from 19 percent of the area to 12 percent (SSW Environmental Assessment). After removal of snags for safety reasons and down logs during underburning, rare ponderosa pine old-growth stands will no longer meet the minimum old-growth requirements in the sale area (*id*). The SSW EA admits:

> Populations of many of the wildlife species associated with large diameter ponderosa pine forests . . . were probably reduced to remnants of their pre-settlement levels by 1937, and have likely not recovered to any extent since then. Many of these species are actually dependent on one or two of the habitat components associated with older forest, most notably large diameter snags.

Furthermore, the Forest Plan requires the District Ranger to defer harvest in one management area where old-growth harvest will violate Forest Plan standards. Instead she decided to amend the Forest Plan to fit the decision, rather than amend the decision to comply with the Forest Plan.

What started out as an ecosystem management objective has become a commercial operation to remove timber. The end result will be the loss of old growth that the operation intended to save.

CASE STUDY FOUR

Habitat Suitability Index Models and the Hornet Wedge Timber Sale

In the Hornet Wedge timber sale, the Flathead National Forest used Habitat Suitability Index (HSI) models to analyze the effects of logging and road building on old-growth Management Indicator Species. This sale is planned in highly fragmented habitat, where 53 percent of the timber base has already been cut. In spite of the marginal state of the existing old-growth resource, the Forest Service used HSI models to determine that the sale would not impact the designated old-growth indicator species, pileated woodpecker and pine marten.

Extensive analyses of Forest Service records and methodologies by population modeling specialist Dr. Jack Gross, showed that the Forest Service admitted they "fudged the [HSI] model" to allow cutting (see Hornet Wedge Project Records, Meeting Notes #11, 8/19/91; and Gross 1992). Despite misusing the model, the timber sale plan failed to satisfy even the minimal standards for pileated woodpecker and pine marten set by the HSI model (Gross 1993, Caton 1993). The end result is that the MIS blocks identified by this sale plan are of insufficient size, continuity, and quality to support viable MIS populations (*id.*). The MIS blocks are fragmented, "empty shells" containing clear-cuts, while omitting nearby old-growth and mature forests (*id.*).

> *Extensive analyses of Forest Service records . . . showed that the Forest Service admitted they "fudged the model" to allow cutting*

POSITIVE EXAMPLES OF OLD-GROWTH/ ECOSYSTEM MANAGEMENT

The examples below show positive steps taken by Region 1 Forests and the public with regard to old-growth management. The examples, although not perfect, can serve as models for improved management.

Idaho Panhandle National Forests: Defer Harvest of Old Growth Until Inventory is Complete

The Idaho Panhandle National Forests are developing the most complete old-growth inventory in Region 1. In the interim, however, the Forest Service was unable to assure the Spokane Audubon Society that it could meet its Forest Plan obligation to retain 10 percent of forested acres as old-growth, while continuing to cut old growth. In response to this concern, Idaho Panhandle National Forests' Supervisor, William Morden, directed District Rangers to cease cutting old growth for one year to allow further collection of inventory data (March 27, 1990 letter to Suzanne Hempleman).

Supervisor Morden directed that priority for selection of allocated old growth be given to the oldest and rarest stands (Morden 1991). Selection of the stands to be retained incorporated several concepts from the field of conservation biology: large intact blocks greater than 300 acres were given priority for retention, isolated patches of old growth were linked with larger blocks, and small patches of unique old growth less then 80 acres were surrounded by a buffer. (Although buffering stands is an improvement, if the object is to maintain the integrity of interior forest conditions, a stand would have to be considerably larger than 80 acres, depending on the stand's shape, orientation and degree of isolation [Harris 1984]). Because some Districts did not contain the minimum 10 percent old growth required, other Districts containing greater than 10 percent old growth increased their allocations accordingly (Morden 1991).

> *"Until we have data to better evaluate the effects of woodcutting on snags, [forest managers should] insure that these areas are not open to woodcutting."*
> *Orville Daniels, Lolo Supervisor*

As of September 1993, three Ranger Districts have completed mapping and public involvement in the allocation process, and four Districts are completing their mapping during the 1993 field season, with early

1994 as the expected completion date for the allocation process (Zack 1993).

The Idaho Panhandle National Forests have stressed systematic, Forest-wide inventories, field verification, quality of old-growth forests protected, and public involvement. Not all Districts are complying to an equal degree; however, no other Forests in Region 1 have progressed to this extent.

Lolo National Forest: Until More is Known, Defer Logging in Designated Old-Growth Management Areas and Rare Ponderosa Pine Stands

The standards and guidelines set forth in the final Lolo National Forest Plan permitted logging in its old-growth management area, MA 21. In 1991, however, Forest Supervisor, Orville Daniels, "decided to stop harvesting in Management Area 21 until we know more about how to manage old growth" (Daniels 1991a). (Exceptions are permitted after review by the Forest old-growth committee [*id.*]. In addition, not all allocated old growth is protected by Management Area 21 designation.)

The Lolo Supervisor also acknowledged that:

> woodcutting may be adversely impacting Management Area 21. Until we have data to better evaluate the effects of woodcutting on snags, [forest managers should] insure that these areas are not open to woodcutting.

In another positive step, Supervisor Daniels (1991b) required that all ponderosa pine old growth and some groves of ancient forests be protected. The preserves will occur wherever the old growth is found, whether or not it is in the timber base. "[W]e should look at this as an opportunity to perpetuate a limited resource" (*id.*). Although small in acreage, groves containing ancient 600-year-old and 6-foot DBH larch trees, 4- to 6-foot DBH cedar trees, and 300-year-old mountain hemlock have been protected.

Glacier View Ranger District: No Salvage Logging in Old Growth MIS Blocks

In a settlement agreement with Resources Limited regarding the Roots Blowdown salvage sale, the Glacier View Ranger District of the Flathead National Forest agreed to prohibit salvage and sanitation sales in designated blocks of habitat for indicator species (Hope 1990). This agreement is in effect until an old-growth management plan for the Flathead National Forest is approved.

Ecosystem Protection Act

The proposed Northern Rockies Ecosystem Protection Act is the first attempt of its kind to protect roadless area ecosystems and connecting corridors on a broad scale. More old-growth habitat in Region 1 is protected by this proposed wilderness legislation than any other. (Note: only old growth in roadless areas and corridors is protected under this proposed act.)

International Conservation Reserves

The Science Committee of the Flathead Transboundary Council developed an ecosystem-based management plan for the Canadian B.C. and U.S. North Fork portions of the Flathead River basin. This plan for an International Conservation Reserve was developed using the following: National Audubon Society Adopt-a-Forest maps of candidate old-growth and mature forests, bull trout and cutthroat trout spawning and rearing streams, sensitive soils, cut-over areas, management indicator species, and rare plant and animal species habitat. The Plan seeks to sustain ecosystem health through maintenance and restoration of old-growth forests, bull trout habitat, roadless lands and outstanding natural areas, and by reestablishing ecosystem connectivity along an elevational gradient.

Old growth must be maintained, not only for the needs of single species, but also for its own inherent value and all its integral parts

The Greater Ecosystem Alliance of Bellingham, Washington is also in the process of developing a proposal incorporating principles of conservation biology for the Columbia Mountains of Idaho, Montana and British Columbia. Audubon's Adopt-a-Forest maps are being used in this project as well.

RECOMMENDED MANAGEMENT CHANGES

The following recommended management changes can be implemented immediately based on available data or are clearly justified based on lack of available data. These may be adapted according to new information as it becomes available. (See also recommendations for further study listed below.).

1. Manage for old-growth biodiversity, rather than MIS alone. Old growth must be maintained, not only for the needs of single species, but also for its own inherent value and all its integral parts (Jones 1984, Habeck 1988, U.S.D.I. 1992). *(See discussion on pages 14–16.)*

2. Manage for the persistence of old-growth forests throughout time. The amount of old growth that should be protected must be large enough to ensure:

> against inevitable losses through natural fires and other disturbances. Many researchers (*e.g.*, S.T.A. Pickett and J.N. Thompson. 1978. Biological Conservation 13: 27-37) have noted that total habitat area must be large enough to maintain a diverse mix of seral stages and associated species when the patch size of natural disturbance is large, as it is in the northern Rockies.
>
> (Noss 1992).

Because stand replacing fires in Region 1 are generally large, this must be considered when determining how much old-growth habitat is enough. This will substantially increase the amount of old-growth habitat that must be protected, above what is commonly regarded as the "minimum" requirement for old-growth dependent and associated wildlife species.

Lolo National Forest biologists have determined that unless old growth is removed from timber management allocations, maintaining 10 percent of forest stands at 250 years old would require a 250-year rotation for at least 28 percent of the area (Harger 1978). Some old-growth types at 250 years are just beginning to exhibit old-growth characteristics (McClelland 1985, Spies and Franklin 1991); therefore, in order to maintain a true diversity of old-growth types, old-growth stands should be managed to survive for centuries more. *(See discussion on pages 8–9 and 29.)*

3. Provide equitable old-growth distribution among all old-growth types and elevational gradients. The percentage of old growth retained should be calculated not only on subset analysis areas small enough to provide proper distribution of old-growth indicator species (*e.g.*, 2,000 to 3,000 acres for pileated woodpeckers; McClelland 1987), but also on District-wide and Forest-wide analysis areas. The subset basis provides relatively even distribution of old-growth across a District. The District-wide and Forest-wide bases

© R. YANISHEVSKY

This old-growth cedar grove on the Lolo National has attained a state of ecological climax.

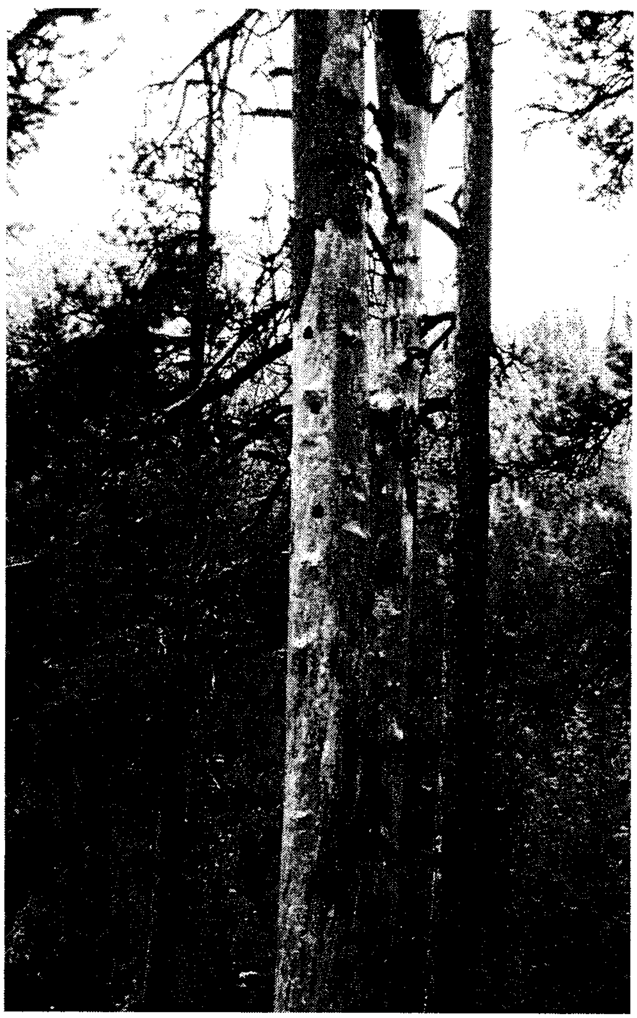
prevent piecemeal planning that could incrementally reduce old-growth habitat below the level needed to maintain viable populations of species over the long-term. *(See discussion on pages 8–9, 11–12 and 32.)*

4. Defer logging in all western redcedar, ponderosa and white pine mature and old-growth forests. After decades of logging, the western redcedar and ponderosa pine old-growth forest types are too rare to risk further loss, degradation, or fragmentation. Maintenance of viable populations of species will in all likelihood require the Forest Service to restore habitat, therefore mature forests of the cedar and ponderosa pine types warrant protection because these forests are candidates to become the old growth of the future. White pine that are resistent to blister rust are important genetic reservoirs. *(See discussion on pages 11–12.)*

5. Restore fire to fire dependent old-growth forest types. The ponderosa pine old-growth type has been the most severely impacted by fire suppression. In some cases, fuel buildup and encroachment of species that act as fuel ladders prohibit the use of prescribed burning.

Thinning should be done on an experimental basis, first in mature stands (not old growth), to determine the best way to simulate ecological processes that create natural mosaics of old-growth forests, without causing residual stand damage. Thinning should not be designed for commercial purposes; the object should be to restore the stand to old-growth conditions. Any commercial gain should be a secondary benefit. Ecological damage from the operation must be strictly avoided. Non-mechanized, labor intensive means should be used where appropriate and should not be discounted for economic reasons. *(See discussion on pages 13–15.)*

6. *Ensure the effectiveness of old-growth Management Indicator Species.* Expand the number of MIS required or otherwise demonstrate that MIS standards will provide for the long-term viability of all indigenous old-growth dependent and associated species, including the northern goshawk, fisher, Canada lynx and flammulated owl. *(See discussion on pages 14–16.)*



© J. HOFFLAND

For nesting pileated woodpeckers prefer tall, large-diameter snags and broken-top trees.

7. *Restore diminished and extirpated populations of old-growth dependent species to their native ranges.* For instance, populations of Canada lynx and flammulated owl must be recovered, and restoration programs for woodland caribou and fisher must be expanded to encompass their native ranges. *(See discussion on pages 26–27.)*

Significant information gaps make Region 1 old-growth management a high risk enterprise. The Forest Service should therefore apply a margin of safety by implementing the above management recommendations.

8. *Implement effective standards for maintaining populations of Management Indicator Species and monitoring.* MIS standards must meet the viability requirements set by the National Forest Management Act and implementing regulations. Therefore, they must be based on "current inventory data appropriate for planning" and "the best available data." 36 C.F.R. 219.12(d). *(See discussion on pages 14–16 and 30–31.)*

9. *Implement effective snag standards and monitoring.* Snags are an important component of forest health and forest biodiversity, yet snag standards are poor or non-existent on most Region 1 Forests. Snag habitat has been severely compromised putting the viability of snag dependent species at risk. *(See discussion on pages 13, 14–16 and 30–31.)*

10. *Prohibit firewood cutting, salvage logging and road building in old-growth habitat.* Key components of old-growth habitat include snags and down logs. Firewood cutting and salvage logging remove these old-growth components from the ecosystem and adversely affect species which are dependent on them. Since certain old-growth dependent species, such as woodpeckers, are effective predators of forest pest organisms, removal of their required habitat could cause a chain reaction of increasing pest outbreaks and declining forest health. Road building increases fragmentation of forest ecosystems that are already marginally functional due to existing fragmentation effects. Roads should not be located where they will exacerbate existing problems. *(See discussion on page 13.)*

11. Close and rehabilitate all nonessential roads within or adjacent to old-growth habitat. To reduce fragmentation effects and disturbances caused by existing roads, closure and rehabilitation of nonessential roads in old-growth areas will serve to prevent further damage to old-growth habitat. *(See discussion on page 13.)*

12. Defer new timber sales within all remaining mature and old-growth forests until significant identified gaps in data, inventory and analysis are filled with scientifically credible information. Until baselines are established for populations of old-growth dependent species, and until management standards can be supported by these baselines and additional monitoring data, future options should be preserved by deferring harvest in all mature and old-growth forests. *(See discussion on pages 25–27.)*

We lack some of the most basic knowledge about old-growth forests and their associated species in Region 1. Only a surprisingly small amount of relevant research is available or in progress.

13. Develop an old-growth ecosystem management plan. An old-growth ecosystem management plan must be prepared by an independent scientific panel, based on the best available information, including standards for old growth amount, quality, distribution and continuity. *(See discussion on pages 22 and 32.)*

We lack some of the most basic knowledge about old-growth forests and their associated species in Region 1. Only a surprisingly small amount of relevant research is available or in progress. This contrasts with the relatively more complete body of research and inventories for the Pacific Northwest. Significant information gaps make Region 1 old-growth management a high risk enterprise. The Forest Service should therefore apply a margin of safety in implementing the above management recommendations.

IDENTIFICATION OF AREAS FOR FURTHER STUDY

Extensive studies in the Pacific Northwest Region, such as the five year, $2 million study on old-growth community ecology by the U.S.D.A. Forest Service's Old-Growth Forest Wildlife Habitat Research and Development Program (Ruggiero *et al.* 1991), can serve as a blueprint for similar studies needed in Region 1. A caveat of the Pacific Northwest research program was its inability to carry out more intensive species-specific studies and forest fragmentation studies due to funding cuts. The duration, scale, and sampling and replication strategies of the recommended studies should be designed according to elements in Carey and Spies (1991), Ruggiero *et al.* (1991) and Dobkin (1992), allowing for landscape-level evaluations and natural variation (*e.g.*, climate). A study plan for Region 1 would also require a detailed evaluation of ongoing and existing research.

The objectives of the studies, generally listed in order of priority for accomplishment, follow. Some studies can be achieved in a short time frame (1 to 2 years) while others are longer term (2 to 10 years). Depending on the level of interim protection afforded during completion of these studies, the suggested priority ranking of these studies may be altered.

1. Old-growth definition and inventory. Develop a peer-reviewed, scientifically supportable old-growth definition and prepare a field-verified inventory of old-growth forest ecosystems in Region 1. An old-growth inventory and definition should go beyond identifying the minimum old-growth characteristics. It is more correct to think of old growth as a developmental gradient rather than a discrete type; therefore, Franklin and Spies (1991) have proposed an old-growth index that describes the degree to which a forest stand provides the various attributes of old growth or "old growthness". Inventory data should therefore be as comprehensive as practically possible. For example, in habitat types where trees may reach diameters of 30 inches; rather than tallying only down logs larger than 10 inches DBH and standing trees greater than 20 inches, data should be obtained on larger size classes as

Inventorying old-growth forests in Region 1 is a major task, but one that is urgently needed and can be performed in a reasonable time frame as demonstrated by the Idaho Panhandle National Forests.

well (*e.g.*, 20–25", 25–30", 30–35" DBH) to distinguish the stands that have a higher degree of "old growthness". Stands with higher old-growth indices are probably more rare and susceptible to being lost as an element of biodiversity.

A database of old-growth inventory information should be maintained on a continuing basis, and should include at least the following: old-growth forest and habitat type; structural quality by quantifiable attributes (*e.g.*, tree age, diameter, height and density, including snags and down logs, decay class, special features); interior forest conditions (*e.g.*, stand/grove size, shape, and aspect); landscape continuity (*e.g.*, degree of isolation due to fragmentation, corridor connections); and vulnerability to human disturbance (*e.g.*, open and closed road proximity, logging, recreational use). As data are obtained to more accurately define old growth and the particular values sought for retention, this will facilitate the design of a data base with the most relevant and useful information for managing old-growth forests.

Determine the biological requirements and ecological relationships of species that are either found only in old growth or find optimum habitat there.

Inventorying old-growth forests in Region 1 is a major task, but one that is urgently needed and can be performed in a reasonable time frame as demonstrated by the Idaho Panhandle National Forests.

2. *Wildlife and plant species inventory.* Identify wildlife and plant species that are dependent upon or find optimum habitat in old-growth forests. A representative sampling of old-growth forests should be conducted across all elevations, habitat and cover types, etc.; however, it is most critical to first inventory stands that are rarest or most threatened; *e.g.*, large, unfragmented stands at low and mid-elevations with no or minimal management activities.

3. *Ecology of old-growth species.* Determine the biological requirements and ecological relationships of species that are either found only in old growth or find optimum habitat there. Ecological studies of old-growth dependent and associated species should be designed to elicit reliable information on specific habitat use, nesting/denning and foraging requirements, dispersal, and survival rates to enable Forest Service managers, scientists, and the public to draw conclusions about population viability. Such studies should focus on old-growth species that are most likely to decline in managed forest landscapes (such as the flammulated owl, pileated woodpecker, pine marten and northern goshawk), keystone species (such as insectivorous birds that prey upon forest insect pests), special status species such as sensitive, threatened, or endangered, and other species identified in old-growth inventories.

Performing the necessary wildlife and plant inventories (*e.g.*, Hutto in progress, Lesica *et al.* 1991) and ecological studies (*e.g.*, McClelland 1979, Jones 1991) is a major task, but is achievable with properly designed sampling strategies.

Dead standing trees and down wood are important components of old-growth forests. The Forest Service should determine the effects on the ecology of old growth caused by removal of these components through salvage and sanitation logging.

4. *Effects of management.* Evaluate the effects of management on the ecology of old-growth forests. It is important to investigate the impacts of habitat fragmentation, and salvage and sanitation logging because these activities have a great potential to alter the ecology of old growth forests. Forest fragmentation alters the spacing, size, shape, context and amount of edge in old-growth stands in the landscape. There is a paucity of information on the impacts of fragmentation on Region 1 wildlife populations and trends (examples include Aney 1984, Hejl in progress), and on the structure, function and composition of old-growth ecosystems. Salvage and sanitation logging also alter the ecology of old-growth forests. It is critical to investigate the impacts of all these activities.

Dead standing trees and down wood are important components of old-growth forests. The Forest Service should determine the effects on the ecology of old growth caused by removal of these components through salvage and sanitation logging. Effective snag and down log management standards for managed stands cannot be developed without a reliable inventory of snags in salvaged and unsalvaged old-growth stands, in even-aged managed stands, and along open roads. In addition, it is necessary to know how long it takes after salvage activities to replace snags and down logs and how long they persist. This will require studies of snag and down log recruitment/succession in natural and managed forests.

Most Region 1 forests have moved at a laggard's pace to achieve what should be the first step in planning

Studies on the role of fire and Forest Service management of fire in old-growth forests are also necessary for a comprehensive understanding of old-growth ecosystems. Studies are necessary on the effects of natural and prescribed burns, fire suppression, post-fire salvage logging, and alternative means of managing fire.

5. *Old growth biodiversity.* Determine the contribution of old-growth forests to overall biological diversity. The role of Region 1 old-growth ecosystems in maintenance of overall forest health should be thoroughly investigated. For example, what is the role of avian and insect predators in controlling damage from forest pests, and what is their influence on surrounding forests? What is the role of mycorrhizal fungi in vascular plant growth and regeneration? What is the role of old-growth stands as refugia and as centers for dispersal of diverse species into surrounding forests? What are the impacts of management on these various factors?

Studies should be performed on the ecological differences of old-growth stages; i.e., "young," "middle," and "old" old-growth stands. Also, studies to determine the actual time necessary for different forest types to be dominated by old-growth trees are important in understanding the long term persistence of viable old-growth ecosystems (*see e.g.,* Arno and Scott 1994). The summary of findings of the Pacific Northwest Old-Growth Wildlife Habitat Program discusses the importance of applying the results of old-growth research to management decisions and determining future research needs (Holthausen and Marcot 1991). Lessons learned through hindsight in the experience of Pacific Northwest old growth managers can be applied with foresight in the Northern Rockies.

CONCLUSION

Despite more than a decade of Congressionally mandated National Forest planning, most Region 1 forests have moved at a laggard's pace to achieve what should be the first step in planning — producing reliable, field-verified inventories of old-growth habitat and associated wildlife. Old-growth maps based on LANDSAT satellite imagery were developed using a Forest Service computerized Geographical Information System (GIS) (Flathead National Forest Old-Growth MIS DEIS, 1992). However, these maps have proven unreliable (Nel 1992, Noss 1992, Schultz 1992a). Required monitoring of old-growth dependent wildlife has often not been conducted and, when it has occurred, baseline data are insufficient to make it meaningful (*see* Appendix Table 3). The few Region 1 Forests in which snags have been monitored are finding serious noncompliance with Forest Plan standards (*see* Appendix Table 3). Even in the best cases, old-growth habitat and wildlife standards fail to incorporate the best scientific data, and, equally important, they fail to adequately account for what is not known.

Region 1 National Forests use minimum and below minimum standards for maintaining habitat to support old-growth wildlife. In addition, old-growth logging continues to proceed despite the absence of a scientifically credible old-growth definition, without a comprehensive inventory of old-growth forests and wildlife, and without a plan to prevent further fragmentation and depletion of the now rare lower elevation old-growth stands. Given the fundamental informational and procedural gaps identified in this paper, and the large amount of old growth already lost, it is clear that the Forest Service can offer no reasonable assurance that the Northern Rockies will maintain viable old-growth ecosystems into the next century.

It is a common mistake for multiple use land managers to assume that if something is necessary for wildlife, managers will be able to determine the minimum amount needed and apply that to every situation (Conner 1979). This misapplied management concept devalues one of the very essences of biodiversity — randomness. Duff layers many feet thick and the complex ecosystems they support cannot arise from the few small down logs that Region 1 Forest Plans prescribe. They arise from many windthrow trees —perhaps all at once, perhaps over a number of decades (either would produce a different end result)— which may take a century to decompose, depending on microclimate, tree size and species, over which time a multitude of additional random events will occur. These include lightning, animal diggings, wind deposition, establishment of nitrogen fixing lichens. Diversity is the antithesis of sameness; it is spatial and temporal randomness.

If one thing can be said about old growth, it is that no two stands are alike. Moreover, the degree of difference among old-growth stands is greater than the degree of difference among young stands (Lesica et al 1991, Spies and Franklin 1991). In statistical terms, older forests have a higher coefficient of variation. Some differences are obvious, such as variations in tree diameters and heights; but less obvious characteristics also develop so that each tree, like an aging person, has its distinguishing features. Each square meter of soil has its own history and hence its own diversity. We do not yet have the knowledge or ability to replicate this. Nor does anyone know how many centuries it takes for a stand, once cut, to become old growth again. National Forest management, instead of homogenizing the forest, must strive to do the opposite.

Literature cited herein are listed after the Appendix.

Appendix

A Comparative Analysis of Old-Growth and Snag Management in Region 1

Rosalind M. Yanishevsky, Ph.D.,
Thomas E. Owen, and John R. Hoffland

A summary of old-growth management and snag management on the 13 National Forests of Region 1 was published by Yanishevsky (1987). This Appendix presents an updated version that reflects the release of all final Forest Plans, and current revisions and amendments. The authors reviewed these Forest Plan documents, the annual and 5-year Monitoring Reports for the Forests, and talked to numerous Forest Service personnel to determine the status of old-growth management and snag management in Region 1. The major results of this investigation are presented in three tables that show, for each of the 13 National Forests: old-growth management standards, snag management standards, the list of old-growth Management Indicator Species (MIS), and the status of monitoring efforts for snags and old-growth MIS.

OLD-GROWTH MANAGEMENT STANDARDS IN REGION 1

Old-growth retention is a management strategy utilized in most Region 1 Forest Plans to help ensure long-term persistence of biological diversity represented in old-growth ecosystems. Region 1 Forest Plans exhibit almost as much variation in their requirements for old-growth retention as there are National Forests (Table 1). Ten percent, the maximum amount of old growth required to be retained by any Forest, is insufficient because it does not account for expected losses of old-growth forests through time due to natural causes, such as stand-replacing wildfires and windthrow (Yanishevsky 1987, Norse 1990). Such low retention requirements also fail to account for diminished habitat effectiveness due to fragmentation from road building and logging (*id.*). When striving to maintain old-growth species throughout their native ranges, it is ill advised to reduce any portion of a Forest (*e.g.*, a third order drainage or a timber compartment) below the nominal old-growth retention requirement. For example, although the Clearwater and Nez Perce National Forests require retention of 10 percent old growth forest-wide, they require retention of only five percent per timber compartment (Table 1). The Region 1 MIS Monitoring White Paper (1989) notes:

> [M]any Forests [are not] in the position of being able to justify allocations made to provide for species viability. For instance, while the Helena and L&C [Lewis and Clark] both require 5 percent old growth . . . I'm not sure how they reached the number or how they can defend it.

All Forests allow some kind of logging in allocated old-growth stands, with the exception of the old-growth management area on the Kootenai National Forest and old-growth MIS blocks on the Glacier View Ranger District, Flathead National Forest (Table 1). Only the Lolo, Kootenai, and Nez Perce Forests have specific Management Area designations for old-growth habitat (Table 1). Designating old-growth Management Areas provides the opportunity to remove these old-growth stands from the timber base.

The Kootenai National Forest removed its old-growth Management Area from the timber base; however, not all designated old growth is within the Management Area.

Old-growth stands, once designated through the forest planning process, cannot be deleted without appropriate documentation. On the other hand, when allocated old-growth areas are not designated in the Forest Plan, old-growth allocations become "movable." Old growth set aside in one timber sale (*e.g.*, Roots Blowdown Salvage 1990) can be redesignated in another sale (*e.g.*, Hornet Wedge 1993) and become available for logging.

For those old-growth stands which are to be retained, most Forests have a minimum stand size requirement (not shown in table). This requirement ranges from 10 to 50 acres, which is far too small to meet many species' habitat requirements (Kootenai Forest Plan, Rosenberg and Raphael 1986, Wilcove *et al.* 1986, Yanishevsky 1987). Bigger is better (Noss 1987), but because today's landscape is highly fragmented, and the remaining old-growth fragments are so rare, it is not acceptable to clear cut an old-growth stand simply because it is too small (U.S.D.A. Forest Service 1993b). It is preferable to retain a buffer of mature forests to reduce edge effects, thereby increasing the size of the retained old growth by maintaining as much interior forest habitat as possible (Harris 1984). The Idaho Panhandle National Forests buffer small stands that are to be retained with additional forest so that "preferably" at least 80 acres are protected. Although increasing the stand size will improve the stand's habitat effectiveness for some species, 80 acres are not sufficient to maintain interior forest conditions (Kootenai Forest Plan, Rosenberg and Raphael 1986, Wilcove *et al.* 1986). When large blocks of old growth exist within a timber compartment, the Idaho Panhandle requires retention of large blocks greater than 300 acres, which is large enough to maintain interior forest conditions. Unfortunately, three 100-acre blocks may be substituted for one 300-acre block. These may be equivalent acres, but they are not equivalent habitat due to edge effects. The Nez Perce National Forest has a similar requirement.

SNAG MANAGEMENT STANDARDS IN REGION 1

The Forest Service manages snags because snags serve many important ecosystem functions. For instance, large snags offer denning and nesting sites for cavity dwelling birds and mammals including the pileated woodpecker, and serve as a recruitment source for large woody debris (*e.g.*, Norse 1990). Most Forests use the pileated woodpecker as an old-growth MIS (Table 3). McClelland (1977 and 1989) found that pileated woodpeckers select on average 30 inch DBH nest trees (mostly snags and broken-top trees) in northwest Montana, and experts have assigned trees of 20 inches DBH or less a Habitat Suitability Index of zero (Aney and McClelland 1984). In spite of these notable findings, approximately half of the Forests in Region 1 require snags no larger than 10 inches DBH (Table 2). No Forest except the Clearwater requires retention of trees greater than 20 inches DBH. The Clearwater has snag standards that more closely approximate pileated woodpecker requirements than other Region 1 forests, with 18 inches DBH for feeding trees, 25 inches DBH for nest trees and 50 feet in height. The Bitterroot uses the pileated woodpecker as its old-growth MIS, but has not yet specified snag size requirements.

Snag height requirements (not shown in table) are clearly inadequate on Region 1 Forests. While the average height of pileated woodpecker nest trees in northwest Montana is 92 feet (McClelland 1979), Forest Service snag height standards are 15 feet on the Lolo, 18 feet on the Gallatin, and the Flathead uses an incredulous 3 feet (Old Growth Walk Through Survey Form -Flathead NF).

To compensate when there are no snags, most Forests require that some green trees be retained as snag replacements (Table 2). However, it is the rare exception that green tree replacements are retained where they are needed in other situations to compensate for the expected attrition of snags through firewood cutting or natural causes (*e.g.*, the Gallatin Forest Plan Amendment No. 15, 1993).

Leaving trees of the proper species and stage of deterioration is critical for cavity nesting habitat (McClelland 1979), but five Forests have no requirements for tree species preference. Forest Plan monitoring data show that even when there are requirements for tree species preference, these and other snag retention requirements are not being met (*e.g.*, Lolo Forest Plan 1987 and 1992 Monitoring Reports; Kootenai Forest Plan 1992 Monitoring Report; Gallatin National Forest Timber Sale Monitoring FY92 South Plateau Timber Sale, Hebgen Lake Ranger District).

MONITORING OLD-GROWTH MIS AND SNAG HABITAT STANDARDS IN REGION 1

The most common old-growth Management Indicator Species (MIS) used by Forests in Region 1 are: the pileated woodpecker, marten, and northern goshawk (Table 3). The fisher requires more old-growth habitat than most, if not all, old-growth dependent wildlife species in Region 1 (*e.g.*, Harger 1978, Freel 1991, Schultz 1992c), but the Nez Perce is the only Forest that lists the fisher as an old-growth MIS (Table 3). Therefore, other MIS species that may persist with less old-growth habitat do not serve as good indicators of the viability of fisher populations.

Table 3 shows that of 13 Forests in Region 1, four do not even require monitoring of designated old-growth indicator species. The Kootenai and the Deerlodge Forests, although required to monitor old-growth MIS, have failed to do so. The remaining Forests that are monitoring MIS still do not have sufficient data, nearly 5 years into the planning cycle, to demonstrate MIS population trends. Nevertheless, these Forests' timber programs continue essentially unquestioned.

Eight Region 1 Forests list the pileated woodpecker as an old-growth indicator species, yet only three Forests are performing monitoring. Ten Forests list the pine northern goshawk, and only half are monitoring. No Forest has collected sufficient data to monitor population trends.

Our investigation shows that very few Forests are monitoring species designated in Forest Plans as indicators of snag habitat conditions (not shown in tables). The Helena Forest designated the hairy woodpecker and the Lewis and Clark designated the three-toed woodpecker as snag management indicator species. This appears to be only a paper exercise because the Forests are not monitoring these species.

Table 3 also displays the extent of snag habitat monitoring by Region 1 Forests. Such monitoring is required on only about half of the Forests (Table 3). The Deerlodge is required to monitor snags, but has failed to fulfill this obligation due to lack of funds (Elsbernd 1993). Even on Forests that monitor snag habitat, many timber sale projects are not monitored (*e.g.*, Gallatin National Forest 1992 Monitoring Report). Although some timber sales, as planned, may meet snag standards (*e.g.*, on the Helena National Forest, Sauerkraut Timber Sale Review Write-Up, 1993), overall there remain serious problems with snag retention. Snags are not marked properly before the sale (*e.g.*, Helena National Forest, Westside Timber Sale Review Write-Up, 1990); are felled by timber purchasers (*e.g.*, Gallatin National Forest, Rainbow/Whiskey Timber Sale Monitoring Report, 1992); and/or are lost after the sale due to broadcast burning or firewood cutting (*e.g.*, Lolo National Forest 1992 Monitoring Report).

According to the Interim Snag Management Guidelines for the Bitterroot National Forest:

> [M]ost or all of the snags now standing in broadcast burn units will either be felled because they are a high safety risk . . . or will be burned . . . Retention of enough snags to make a difference now seems infeasible, except in tractor-or hand-piled units.

In addition, "[s]ince almost all snags in harvest units are now considered safety risks, very few dead snags are being left." (Bitterroot National Forest Plan Monitoring and Evaluation Report Summary, 1992).

The Lolo National Forest shows an average 35 percent compliance with snag standards; one District is as low as 12 percent (Lolo National Forest 1992 Monitoring Report). The Lolo retains green replacement trees in an attempt to compensate (*id.*); however, until these live trees die and/or develop sufficient decay to be usable by cavity nesters, they will not contribute to snag habitat requirements.

In 1987, the Kootenai Forest, with its relatively progressive Forest Plan snag retention provisions, promised to be one of the best in the Region for snag management (Yanishevsky 1987). The 1992 Kootenai Monitoring Report, however, showed that the management scheme had failed to maintain compatibility between the Forest's timber program and its duty to maintain viable populations of snag dependent species. The report indicated that drainages where extensive logging had occurred were probably already below the level of snags required by the Kootenai Forest Plan for minimum viable populations. It further indicated that drainages still meeting the snag requirement were in compliance only because of the amount of unlogged areas.

NATIONAL AUDUBON SOCIETY ADOPT-A-FOREST MAPS

National Audubon Society's Adopt-a-Forest program was initiated in 1990 to compile maps of 45 Ranger Districts on 10 National Forests in Montana. Data for mapping were obtained from the U.S. Forest Service; the Montana Department of Fish, Wildlife, and Parks; the Montana Natural Heritage Program; and ongoing cooperative research projects. Although these data already existed, they had not been previously compiled into a comprehensive set of maps to allow landscape level analysis.

In Phase I of the mapping project, candidate old-growth or late successional forests are mapped on U.S.G.S. quadrangle maps (2.64"/mile) for each Ranger District. Additional overlays show mature forests, past logging activity, suitable and unsuitable timberlands, proposed timber sales, and a contour limit to delineate low-elevation lands.

Phase II maps are done on a smaller scale (1/2"/mile) that displays an entire National Forest. These maps show old-growth and mature forest stands, and they delineate intact blocks or "groves" of old growth greater than 200 acres in size. For each grove, the following information is compiled: total grove acreage, tree species composition and acreage, presence of roads, presence of riparian areas, acreage of old-growth and associated forest (non old-growth stands that help to buffer or otherwise maintain the integrity of the grove), planned timber sales, and elevation (low or high).

Phase III maps add additional overlays to the Phase II maps showing important fish spawning and rearing streams, sensitive soils, roadless lands, roads, and habitat for Management Indicator Species, and uncommon plants and animals.

The purpose of the Adopt-a-Forest maps is to provide a landscape view of candidate old-growth forests to facilitate public participation in public land and resource management. The maps help in ranking old-growth stands, with the highest priority stands composed of the largest diameters, heights, trees per acre, and basal area. Also highlighted are low-elevation stands, large intact groves of old growth, and western redcedar and ponderosa pine old-growth types. Mapping mature forest stands is useful in spatially configuring contiguous corridors to link necessary habitat elements and in identifying mature stands to effectively buffer small, isolated stands of old growth.

Audubon's maps also facilitate evaluation of the distribution and quantity of old-growth stands and the spatial correlation between old growth and other biological values. The degree of fragmentation can be assessed from past logging and roading. The impact of proposed logging and road building activities on associated fisheries, sensitive soils, roadless lands, old growth, and wildlife habitat can also begin to be assessed.

The following is an example of how the information embodied in Adopt-a-Forest maps can be used to suggest a planning strategy. On the Glacier View Ranger District of the Flathead National Forest, the maps show that groves greater than 200 acres containing low-elevation old growth are uncommon. Although Audubon's maps indicate that approximately 10 percent of the forested land below 5,000 feet is in an old-growth condition, of the 24 groves found, none were located entirely below 5,000 feet elevation. Historical analyses at similar elevations indicate that 28 percent of the major forest type was old growth (>200 years) (Hart and Lesica 1993). Although these percentages are not precisely comparable, they do illustrate a dramatic reduction in the amount of lower elevation old growth.

In addition, only 3 groves out of 24 total are composed entirely of old-growth stands. Only 5 groves are 90 percent old growth or greater, and only 3 groves on the Glacier View District are larger than 1,000 acres.

These analyses indicate that groves that are lower in elevation, unfragmented and large are relatively scarce compared to historical conditions; therefore, they should receive higher priority for retention. The maps reveal there is almost no opportunity left to maintain these elements of biodiversity on the Glacier View Ranger District.

Assembly of the available data from primarily the Forest Service allowed for relatively rapid and cost effective identification of important areas to protect. Even when additional information is required, it can be gathered and integrated relatively quickly as demonstrated by the Idaho Panhandle National Forests. Establishing the use of readily understandable multiple overlay maps as a primary tool for setting land allocation priorities could dramatically improve both the quality of land and resource management and the efficacy of public participation in that process. Such analyses should be an integral and fundamental part of the agency's planning and decision-making processes.

Table 1

OLD-GROWTH MANAGEMENT STANDARDS IN REGION 1

FOREST	AMOUNT OF OLD GROWTH RETAINED	TIMBER HARVEST IN ALLOCATED OLD GROWTH[3]	OLD-GROWTH MANAGEMENT AREA
Beaverhead	10% of D. fir/spruce per timber compartment	YES	NO
Bitterroot	7.5% of timber base	YES	NO
Clearwater	10% of Forest (5% per timber compartment or drainage)[1]	YES	NO
Custer	None Given	YES	NO
Deerlodge	"about" 10% of major timber management area per 3rd order drainage	YES	NO
Flathead	10% of 3rd order drainage	YES[4]	NO
Gallatin	10% (& 10% mature) per suitable timber compartment	YES	NO
Helena	5% of 3rd order drainage	YES	NO
Idaho Panhandle	10% of forested acres[1]	YES	NO
Kootenai	10% of 3rd order drainage, timber compartment or both[1]	NO	YES[2]
Lewis & Clark	5% of timber management area per timber compartment	YES	NO
Lolo	8% per drainage	NO[5]	YES[2]
Nez Perce	10% of forested acres (5% per drainage & 5% replacement old-growth per drainage)[1]	NO[5]	YES[2]

[1] Includes Wilderness.
[2] Only a portion of required old growth is in this MA.
[3] Includes thinning, salvage and sanitation.
[4] An appeal settlement prohibits logging in MIS blocks on one Ranger District.
[5] Exceptions allowed.

SNAG MANAGEMENT STANDARDS IN REGION 1

FOREST	MINIMUM SNAG DBH (in.)	"LARGE" SNAG DBH (in.)	SNAG REPLACEMENTS	FIREWOOD RESTRICTIONS
Beaverhead	10	NO	NO	NO[2]
Bitterroot	NO	NO	YES	NO
Clearwater	18	25	YES	NO
Custer	NO	NO	NO	NO
Deerlodge	10	NO	YES	1b, 2(200FT), 3
Flathead	10	20	NO	NO
Gallatin	10	NO	YES	2, 5
Helena	7	20	YES	NO
Idaho Panhandle	10	20	YES	2(200ft), 5
Kootenai	10	20	YES	1a, 2(100ft), 3,5
Lewis & Clark	10 (6" in aspen/riparian habitat)	NO	YES	2, 4, 5
Lolo	10	20	YES	1a, 2(200ft)
Nez Perce	12	20	YES	1a

[1]Firewood cutting prohibited: a) in riparian and/or old-growth MA; b) except in gentle terrain.
[2]Snags de-emphasized or located away from open system roads (number in parenthesis gives distance).
[3]Compensation for lost snags.
[4]Road or area closures.
[5]No cutting of signed wildlife trees, education program.

Table 2

Table 3

OLD-GROWTH MIS AND SNAG MONITORING IN REGION 1

FOREST	OLD-GROWTH MIS	OLD-GROWTH MIS MONITORING			SNAG HABITAT MONITORING		
		Required	Performed	Standards Met	Required	Performed	Standards Met
Beaverhead	pine marten, northern goshawk	NO	YES (Goshawk Only)	Insuff. data[2]	NO	NO	No data
Bitterroot	pine marten, pileated woodpecker	YES	YES	Insuff. data[3]	NO	YES	NO
Clearwater	pine marten, pileated woodpecker, northern goshawk	YES	YES (Marten only)	Insuff. data	NO	NO	No data
Custer	northern goshawk	NO	NO	No data	NO	NO	No data
Deerlodge	pileated woodpecker, northern goshawk, 3 toed woodpecker	YES	NO	No data	YES	NO	No data
Flathead	pine marten, pileated woodpecker, barred owl	YES	YES	Insuff. data	NO	NO	No data
Gallatin	pine marten, northern goshawk	YES	YES	Insuff. data	YES	YES	NO
Helena	pileated woodpecker, northern goshawk	NO	NO	No data	NO	YES	NO
Idaho Panhandle	pileated woodpecker, northern goshawk	YES	YES (Goshawk Only)	Insuff. data	NO	NO	No data
Kootenai	pileated woodpecker	YES	NO	No data	YES	YES	NO
Lewis & Clark	northern goshawk	YES	YES	Insuff. data	YES	YES	NO
Lolo	pileated woodpecker, northern goshawk	NO[1]	NO	No data	YES	YES	NO
Nez Perce	fisher, pine marten, northern goshawk	YES	YES	Insuff. data	YES	YES	NO

[1] Habitat monitoring only.
[2] Insufficient data to monitor population trends.
[3] Baseline for pine marten established.

LITERATURE CITED

Aney, W.C. 1984. *The Effects of Patch Size on Bird Communities of Remnant Old-Growth Pine Stands in Western Montana.* Ms. Thesis. Univ. Montana, Missoula. 98pp.

Aney, W.C. and B.R. McClelland. 1985. *Habitat Suitability Index Model for Northern Rocky Mountain Pileated Woodpeckers.* U.S.D.A. Forest Service. Missoula, Montana. 31pp.

Arno, S.F. 1979. *Forest Regions of Montana.* U.S.D.A. Forest Service. INT-218. Intermountain Forest and Range Experiment Station. Ogden, Utah. 39pp.

Arno, S.F. 1987. *Fire Ecology and Its Management Implications in Ponderosa Pine Forests.* In: *Ponderosa Pine: The Species and Its Management.* Symposium Proceedings. Washington State Univ. Coop. Extension. D.M. Baumgartner and J.E. Lotan, eds. Spokane, Wash. pp. 133-139.

Arno, S.F. and W.C. Fischer. 1994. *Larix occidentalis: Fire Ecology and Fire Management.* U.S.D.A. Forest Service. Gen. Tech. Rep. In press.

Arno, S.F. and J.H. Scott. 1994. *Structure of Old-Growth Ponderosa Pine Stands in Western Montana as Influenced by Contrasting Fire Regimes.* In preparation.

Ayres, H.B. 1900. *The Flathead Forest Reserve.* Dept. of Interior, U.S.G.S. 20th Annual Report, Part V; Forest Reserves, Wash., D.C. pp. 245-316.

Ayres, H.B. 1901. *Lewis and Clarke Forest Reserve.* Dept. of Interior, U.S.G.S. Survey; 21st Annual Rep., Part V; Forest Reserves, Washington, D.C. pp. 27-80.

Barrett, S.T.; Arno, S.F. and C.H. Key. 1991. *Fire Regimes of Western Larch-Lodgepole Pine Forests in Glacier National Park, Montana.* Can. J. For. Res. 21:1711-1720.

Barrett, S.T. 1992. *Analysis of Flathead National Forest Old Growth MIS DEIS, Amendment 16.* Resources Limited. 10pp.

Bennetts, R.E. 1991. *The Influence of Dwarf Mistletoe Infestation in Bird Communities in Colorado Ponderosa Pine Forests.* Ms. Thesis. Colorado State Univ., Fort Collins, CO. 83pp.

Campbell, R.W. and T.R. Torgersen. 1982. *Some Effects of Predaceous Ants on Western Spruce Budworm Pupae in North Central Washington.* Environ. Entomol. 11:111-114.

Carey, A.B. and T.A. Spies. 1991. *Sampling Design of the Old-Growth Forest Wildlife Habitat Program.* pp. 9-16. In: *Wildlife and Vegetation of Unmanaged Douglas-fir Forests.* U.S.D.A. Forest Service. Pacific Northwest Research Station, Portland, Oregon. Gen. Tech. Rep. PNW-GTR-285. Ruggiero, L.F.; Aubry. K.B.; Carey, A. and M.H. Huff, eds. 533pp.

Caton, E.L. 1992. Letter to Supervisor J. Holtrop. October 10. 6pp.

Caton, E.L. 1993. *An Evaluation of the Hornet-Wedge Timber Sale Environmental Assessment in Relation to Pileated Woodpecker Habitat Requirements.* Friends of the North Fork. 12pp.

Caton, E.L. 1993. Personal communication.

Conner, R.N. 1979. *Minimum Standards and Forest Wildlife Management.* Wildl. Soc. Bull. 7:293-296.

Cooper, S.W.; Neiman, K.E.; Steele, R.; and D.W. Roberts. 1987. *Forest Habitat Types of Western Idaho: A Second Approximation.* U.S.D.A. Forest Service Gen. Tech. Rpt. INT-236. Intermountain Research Station, Ogden, Utah. 135pp.

Cooper, S.W. 1994. Personal communication.

Daniels, O. 1991a. Treatment of Management Area 21. Memo to District Rangers and Program Officers, Lolo National Forest. Feb. 11. 1p.

Daniels, O. 1991b. Special Grove Management, Legacy Trees and Old Growth Ponderosa Pine Communities. Memo to District Rangers and Program Officers, Lolo National Forest. Feb 11. 2pp.

Dobkin, D.S. 1992. *Neotropical Migrant Landbirds in the Northern Rockies and Great Plains.* U.S.D.A. Forest Service Region 1. Publication No. R1-93-34. Missoula, MT.

Elsbernd, V. 1993. Letter from Deerlodge National Forest Supervisor to J. Hoffland. 15 September 1993. 2pp.

Fisher, R. 1989. Letter to J. Torrence, Regional Forester, January 12.

Franklin, J.F.; Cromack, Jr., K.; Denison, W.; McKee, A.; Maser, C.; Sedell, J; Swanson, F. and G. Juday. 1981. *Ecological Characteristics of Old-Growth Douglas-Fir Forests.* U.S.D.A. Forest Service. Pacific Northwest Forest and Range Experiment Station. Gen. Tech. Rep. PNW-118. 48pp.

Franklin, J.F. and T.A. Spies. 1991. *Composition, Function and Structure of Old-Growth Douglas-Fir Forests.* pp71-82. In: Ruggiero, L.F.; Aubry. K.B.; Carey, A. and M.H. Huff, eds. 1991. *Wildlife and Vegetation of Unmanaged Douglas-fir Forests.* U.S.D.A. Forest Service. Pacific Northwest Research Station, Portland, Oregon. Gen. Tech. Rep. PNW-GTR-285. 533pp.